CLAIMS

What is claimed is:

1. A method for routing a plurality of packets between a plurality of sources and a plurality of destinations in a network, the method comprising:

inserting a source timestamp value into each packet, each source timestamp value indicating the time at which said each packet exits the source;

determining when no additional packets received at a given switch element input will have a source timestamp value earlier than a specified value;

deriving information about source timestamp values of later arriving packets; and

propagating the packets through switch elements in the network in a predetermined order using the source timestamp values together with the derived information about source timestamp values of later arriving packets.

2. The method of claim 1, wherein the predetermined order is the order that the plurality of packets entered the network.

3. The method of claim 1, further including sensing a status message establishing a lower bound on the source timestamp values of the additional packets.

4. The method of claim 1, further including selecting packets to be forwarded in increasing order of their associated source timestamp values.

5. A switching element of an interconnection network for routing a plurality of packets between a plurality of sources and a plurality of destinations via a plurality of paths, the switching element for forwarding packets in an order according to a value of a source timestamp, the switching element comprising:

a plurality of arrival buffers;

a plurality of departure buffers;

means for moving the packets into the plurality of departure buffers so as to cause the packets to be delivered to the destinations;

means for sensing when no subsequent packets which enter each of the plurality of arrival buffers will have a source timestamp having a value earlier than a specified value; and

means for moving the packets from the arrival buffers to the plurality of departure buffers so that individual packets leave each departure buffer in the order according to their timestamp values.

6. The switching element of claim 5, wherein each of the plurality of data packets has associated therewith one of a plurality of priority classes, and wherein each of the plurality of arrival buffers and each of the plurality of departure buffers are operative to accept data packets having associated therewith one of the plurality of priority classes.

7. The switching element of claim 5, wherein each of the plurality of arrival buffers and each of the plurality of departure buffers are operative to accept packets based on intended destination.

8. The switching element of claim 5, further including means for transmitting and receiving packet transmission control messages for selectively postponing reception of data packets.

9. The switching element of claim 5, wherein the sensing means is operative to sense status messages communicated between adjacent switch elements.

10. The switching element of claim 5, wherein the interconnection network is a folded network, the switching element includes first and second groups of arrival and departure buffers and wherein control packets and information packets are transmitted and received via paths in common with data packets.

11. A switching element of for use in an interconnection network for forwarding a plurality of packets in an order according to a source timestamp value, the switching element comprising:

a plurality of arrival buffers;

a plurality of departure buffers;

means for moving the plurality of packets into the plurality of departure buffers;

means for sensing when no additional packets which enter each of the plurality of arrival buffers will have an individual source timestamp value earlier than a specified value; and

means for moving the plurality of packets from the plurality of arrival buffers to the plurality of departure buffers so that individual packets leave each the plurality of departure buffer in the order according to their source timestamp values.

12. A method comprising:

selecting a plurality of candidate packets, each of the plurality of candidate packets being selected from a different one a plurality of arrival buffers and being either one of a plurality of data packets or a status message, the status message acting as a packet substitute having associated therewith a derived timestamp value for indicating that no subsequently-received data packet in a designated arrival buffer shall have a source timestamp value earlier than the derived timestamp value associated with the status message;

comparing said source timestamp values and the derived timestamp values associated with each one of the plurality of candidate packets to determine an earliest timestamp value;

determining a set of candidate packets from the plurality of candidate packets having the earliest timestamp value associated therewith; and

propagating each data packet within the set of candidate packets from a corresponding one of said plurality of arrival buffers to one of a plurality of departure buffers, and creating a new status message in each corresponding one of the plurality of arrival buffers that contains no data packets.

13. The method according to claim 12, further including selecting one of the plurality of departure buffers for each said data packet within the set of candidate packets based on the occupancy of each of the plurality of departure buffers.

14. The method according to claim 12, further including selecting one of the plurality of departure buffers for each said data packet within the set of candidate packets based on a destination of said data packet.

15. The method according to claim 12, further comprising sending a grant signal to an upstream neighbor switching element in order to authorize the upstream neighbor switching element to transmit a new data packet to one of said plurality of arrival buffers.

16. The method according to claim 12, further comprising transmitting either a departure data packet from one of the plurality of departure buffers or a departure status message to each of a plurality of downstream neighbor switching elements.

17. The method according to claim 12, further comprising:

transmitting a first departure data packet from one of the plurality of departure buffers to a first preselected downstream neighbor switching element after receiving a first grant signal from the first preselected downstream neighbor switching element; and

transmitting a departure status message to a second preselected downstream neighbor element after receiving a second grant signal from the second preselected downstream neighbor element, the departure status message indicating an earliest source timestamp value of any data packet that might be subsequently transmitted to the second preselected downstream neighbor element.

18. In a multistage interconnection network for substantially continuously routing a plurality of data packets between a plurality of sources and a plurality of destinations via a plurality of paths, each data packet having associated therewith a timestamp value and a destination value, a method for forwarding the plurality of data packets between a plurality of interconnected switching elements of the multistage interconnection network and for forwarding the plurality of data packets within each of the plurality of interconnected switching elements, the method comprising:

receiving in one of a plurality of arrival buffers within one of the plurality of interconnected switching elements a request-to-send message from each of a plurality of upstream neighbor interconnected switching elements, wherein each said request-to-send message contains one timestamp value associated with a data packet that said upstream neighbor switching element is prepared to transmit to said one of the plurality of interconnected switching elements, and wherein each of said plurality of arrival buffers is uniquely associated with one of the plurality of interconnected switching elements;

selecting a plurality of candidate request-to-send messages from the plurality of arrival buffers;

comparing timestamp values contained in each of the plurality of candidate request-to-send messages to determine an earliest timestamp value; and

for each of the plurality candidate request-to-send messages which contains the earliest timestamp value, performing the following:

sending a clear-to-send message to a corresponding one of the plurality of upstream interconnected neighbor switching elements that is uniquely associated with the corresponding one of the plurality of arrival buffer that contains the candidate request-to-send message;

receiving a data packet from the corresponding one of the plurality of upstream interconnected neighbor switching elements; and

routing the data packet to a departure buffer.

19. A switching element of a multistage interconnection network comprising:

a set of arrival buffers to receive a plurality of packets to be resequenced;

a set of departure buffers to temporarily store packets to be transferred from the switching element;

control logic to recognize when no future packets received at the set of arrival buffers will indicate a source timestamp value earlier than a predetermined value; and

a data transfer mechanism to move the packets from the set of arrival buffers to the set of departure buffers such that individual packets exit each of the set of departure buffers in an order based on the respective timestamp values of the individual packets.

20. The switching element of claim 19, wherein the data transfer mechanism determines in which of the set of departure buffers to place a particular packet based on an indicated destination of the particular packet.

21. The switching element of claim 19, wherein at least a subset of the plurality of packets have associated therewith one of a plurality of service types, and wherein each of the set of arrival buffers and each of the set of departure buffers are operative to accept data packets having associated therewith at least one of the service types.

22. The switching element of claim 21, wherein the service types comprise a service quality or a service priority.

23. The switching element of claim 21, wherein the service types each have an associated priority level; wherein the data transfer mechanism selects a first packet to move to one of the set of departure buffers over a second packet within one of the set of arrival buffers when the first packet has associated with it a higher priority and later timestamp value in the order than the priority and timestamp value associated with the second packet.